REMARKS

Status of the Claims

Claims 1-4 are now present in this application. Claims 1 and 3 are independent.

Claims 1 and 3 have been amended. Reconsideration of this application, as amended, is respectfully requested.

Specification

A substitute specification is attached hereto. Applicant respectfully submits that the filing of the substitute specification does not add any new matter. For instance, the Summary section has been amended to conform to the current claims.

Rejections under 35 U.S.C. § 103

Claims 1-4 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Robotham et al. (US 2004/0100967) in view of Applicant's admitted prior art (hereafter "APA"). This rejection is respectfully traversed.

A complete discussion of the Examiner's rejection is set forth in the Office Action, and is not being repeated here.

While not conceding the appropriateness of the Examiner's rejection, but merely to advance prosecution of the instant application, Applicants respectfully submit that independent claim 1 and 3 have been amended to recite "*the traffic flows forming an aggregate flow*" and "*each shaping group being a portion of the aggregate flow.*" These amendments are supported in the specification as originally filed, e.g., at page 7, 2nd paragraph.

In the Office Action (page 5), the Examiner admits that Robotham does not teach the following subject matter of the independent claims:

> "*- an earliest permitted moment, at which a packet can be forwarded, is defined as a greatest value of Valid Time to Send -values of the shaping groups, to which a traffic flow represented by the packet to be forwarded belongs, and*

> *- as a result of forwarding the packet, the Valid Time to Send -values of the same shaping groups, to which the forwarded packet belongs, are updated, a Valid Time to Send -value of each shaping group expressing an earliest permitted moment, at which a packet belonging under that shaping group can be forwarded without breaking restrictions of speed properties of that shaping group.*"

The Examiner cites to the APA as allegedly remedying these deficiencies. The APA teaches the following:

> "*Figure 1 shows one way, according to the prior art, of monitoring and limiting the speed properties of **a traffic flow**. In the following examination that further elucidates the matter, the term speed properties is used to include mean speed (CIR [bit/s]), burst size (CBS [bit]), by which the mean speed can be exceeded temporarily, and momentary speed (PIR [bit/s]). When packets are begun to be transferred past the measurement point (MP) marked in Figure 1 (i.e. when the first bit of the packet being transferred passes the point MP), the values of the **variables VTS_CIR and VTS_PIR are calculated for the next packet**. VTS_CIR gives the earliest permitted moment in time, when the next packet can be begun to be transferred past MP, in order not to exceed the CIR or the CBS restrictions. Correspondingly, VTS_PIR gives the earliest permitted moment in time, when the next packet can be begun to be transferred past MP, in order not to exceed the PIR restriction. The equations 1 and 2 show the principle generally used for calculating the VST_CIR and the VTS_PIR values.*
>
> $$VTS\_CIR_{next} = max\ (t\text{-}CBS/CIR,\ VTS\_CIR_{prev}) + PKS/CIR, \qquad (1)$$
> *and*
> $$VRS\_PIR_{next} = max\ (t,\ VTS\_PIR_{prev}) + PKS_{prev}/PIR, \qquad (2)$$
>
> *in which t is the time, PKS is the size of the packet in bits, the sub-index 'next' refers to the next packet and the sub-index 'prev' prefers the packet the first bit of which is transferred past point MP at the moment t.*
>
> *When all the speed properties are taken into account, the earliest permitted moment (VTS), when the next packet can begin to be transferred past point MP, is obtained from equation 3.*
>
> $$VTS = max(VTS\_CIR,\ VTS\_PIR). \qquad (3)"$$

(attached Sub. Spec., page 2, line 28 to page 3, line 21; emphasis added).

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In the Office Action (page 5), the Examiner states that "*Specification, equation (3) on page 3, line 17 teaches that if there are more than one VTS values, each associated with one restriction **on the packet flow**, then the greatest VTS value will be selected*" (emphasis added). However, it has to be noted that equations (1)-(3) of the APA relate to **only one traffic flow**.

The Examiner further states that "*Applying the same rule, when there are more than one VTS values, each associated with one shaping group then the greatest VTS value will be selected.*" However, there is **nothing** in the cited prior art or the APA that would teach, suggest, or motivate a person skilled in the art to apply the rule indicated in equations (1)-(3), **which is related to a single traffic flow**, to the situation as recited in the independent claims in which:

- digital information is transferred as constant or variable-length packets as **at least two separate traffic flows**, the traffic flows forming an aggregate flow,

- at least two shaping groups are defined, **each shaping group being a portion of the aggregate flow** and including at least one of the traffic flows and at least one of the shaping groups including at least two of the traffic flows, and

- restrictions of speed properties for the at least two shaping groups are set.

If the APA were to be applied for providing shaping to, e.g., the system disclosed in Fig. 3A of Robotham, this would lead to a system similar to the prior art systems shown in Fig 2 or Fig. 3 of the present application. For instance, if an ordinarily skilled artisan wanted to apply the APA to limit the speeds of the individual traffic flows (C1/RT, C2/RT, C1/nRT, ...) in Fig. 3A of Robotham, he would arrive at a system similar to that shown in Fig. 2 of the present application (note: the multiplexer of Fig. 2 of the present application would correspond to the scheduler arrangement encircled with a dashed-line in figure 3A of Robotham). On the other hand, if the ordinarily skilled artisan wanted to apply the APA to limit the speed of a portion (e.g., 310A in Fig. 3A of Robotham) of the aggregate (318 in Fig. 3A of Robotham) containing more than one traffic flow (307A, 307B in Fig. 3A of Robotham), he would arrive at a system similar to that shown in Fig. 3 of the present application. However, **neither** of the prior art systems shown in Figs. 2 and 3 of the present application involve the aforementioned technical features recited in the independent claims of the present application.

Neither APA nor Robotham discloses any teaching that would make it possible to control a sum rate of two or more traffic flows, which constitute a **portion of an aggregate** of these and many other traffic flows, without the drawbacks related to the prior art system shown in Fig. 3 of the present application. Conversely, such control is made possible by the technical solution offered in the presently claimed invention as recited in independent claims 1 and 3.

Hence, on the basis of the above analysis, Applicants respectfully submit that the combination of elements as set forth in amended independent claims 1 and 3 of the present application is not disclosed or made obvious by Robotham and APA, when considered separately or in obvious combination. Accordingly, reconsideration and withdrawal of this rejection are respectfully requested.

With regard to dependent claims 2 and 4, Applicants submit that these claims depend from independent claims 1 and 3 which are allowable for the reasons set forth above, and therefore claims 2 and 4 are allowable based on their dependence from claims 1 and 3. Reconsideration and allowance thereof are respectfully requested.

Conclusion

All of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicants therefore respectfully request that the Examiner reconsider all presently outstanding rejections and that they be withdrawn. It is believed that a full and complete response has been made to the outstanding Office Action, and as such, the present application is in condition for allowance.

In view of the above amendment, Applicant believes the pending application is in condition for allowance.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Jason W. Rhodes, Registration No. 47305 at the telephone number of the undersigned below to conduct an interview in an effort to expedite prosecution in connection with the present application.

BIRCH, STEWART, KOLASCH & BIRCH, LLP

MKM/JWR/mmi

If necessary, the Director is hereby authorized to charge any fees required during the pendency of the above-identified application or credit any overpayment to Deposit Account No. 02-2448.

Dated: January 29, 2010

Respectfully submitted,

By _____ #47,305

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Attachments

Appl. No. 10/575,710
Docket No. 0365-0674PUS1

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Substitute Specification
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Method and Equipment for Performing Aggregate-portion-specific Flow Shaping in Packet-Switched Telecommunications

Field of the Invention

The present invention relates to a method, according to Claim 1, for performing aggregate-portion-specific flow shaping in packet-switched telecommunications.

The invention also relates to equipment, according to Claim 3, for performing aggregate-portion-specific flow shaping formation in packet-switched telecommunications.

Background

In this publication, the following abbreviations are used in the depiction of both the prior art and the invention:

CBS	Committed Burst Size (greatest permitted burst size [bit]), when exceeding the committed information flow,
CIR	Committed Information Rate (greatest permitted mean traffic speed [bit/s]),
FIFO	First In, First Out discipline,
MP	Measuring Point, in which the speed characteristics of the traffic flow are measured (e.g., mean traffic speed, momentary traffic speed, bust size),
PIR	Peak Information Rate (greatest permitted momentary traffic speed [bit/s]),
PKS	Packet size in bits,
V1, V2,...	Traffic flow 1, 2,...,
VTS	The earliest moment in time, after which the next packet representing a specific traffic flow, or shaping group may be forwarded, in order that not even one rule set for a speed property of the traffic flow or shaping group in question will be broken (Valid Time to Send),
VTSi	The earliest moment in time, after which the next packet representing the

traffic flow i may be forwarded, in order that not even one rule set for a

speed property of the flow in question will be broken,

VTSk   The earliest moment in time, after which the next packet representing the

shaping group k may be forwarded, in order that not even one rule set for

5   a speed property of the shaping group in question will be broken,

VTS_pk   The earliest moment in time, after which a packet may be forwarded, in

order that not even one rule set for a speed property dealing with any

shaping group associated with the packet will be broken (Valid Time to

Send),

10   VTS_CIR   The earliest moment in time, after which the next packet representing a

specific traffic flow, or shaping group may be forwarded, in order that the

greatest permitted mean speed and/or the greatest permitted burst size

will not be exceeded,

VTS_PIR   The earliest moment in time, after which the next packet representing a

15   specific traffic flow, or shaping group may be forwarded, in order that the

greatest permitted momentary speed will not be exceeded.

In packet-switched telecommunications systems, it is often advantageous for it to be

possible to monitor and limit the speed properties of the traffic flow formed of packets

20   being transmitted. A speed property can refer, for example, to the mean traffic speed

(CIR), the size of the burst (CBS) by which the mean speed can be momentarily

exceeded, or the momentary speed (PIR). The traffic flow can consist of, for example,

packets to be routed to a specific transfer link, packets sent by a specific end-user, which

have a specific source address, or packets to be routed to a specific transfer link, which

25   have a specific service class. In the examinations presented in this publication, an

individual traffic flow consists of packets, which are directed to a specific queue, in the

order of their entry to the system, Figures 1, 2, 3, and 4.

Figure 1 shows one way, according to the prior art, of monitoring and limiting the speed

30   properties of a traffic flow. In the following examination that further elucidates the

matter, the term speed properties is used to include mean speed (CIR [bit/s]), burst size

(CBS [bit]), by which the mean speed can be exceeded temporarily, and momentary

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speed (PIR [bit/s]). When packets are begun to be transferred past the measurement point (MP) marked in Figure 1 (i.e. when the first bit of the packet being transferred passes the point MP), the values of the variables VTS_CIR and VTS_PIR are calculated for the next packet. VTS_CIR gives the earliest permitted moment in time, when the next packet can be begun to be transferred past MP, in order not to exceed the CIR or the CBS restrictions. Correspondingly, VTS_PIR gives the earliest permitted moment in time, when the next packet can be begun to be transferred past MP, in order not to exceed the PIR restriction. The equations 1 and 2 show the principle generally used for calculating the VST_CIR and the VTS_PIR values.

$$\text{VTS\_CIR}_{next} = \max (t\text{-CBS/CIR}, \text{VTS\_CIR}_{prev}) + \text{PKS/CIR}, \qquad (1)$$

and

$$\text{VRS\_PIR}_{next} = \max (t, \text{VTS\_PIR}_{prev}) + \text{PKS}_{prev}/\text{PIR}, \qquad (2)$$

in which t is the time, PKS is the size of the packet in bits, the sub-index 'next' refers to the next packet and the sub-index 'prev' prefers the packet the first bit of which is transferred past point MP at the moment t.

When all the speed properties are taken into account, the earliest permitted moment (VTS), when the next packet can begin to be transferred past point MP, is obtained from equation 3.

$$\text{VTS} = \max(\text{VTS\_CIR}, \text{VTS\_PIR}). \qquad (3)$$

In the rest of this publication, a system, by means of which the speed properties of the traffic flow can be monitored and limited, will be referred to as a 'shaper' (SH) while the operation, in which the speed properties of the traffic flow are monitored and limited, will be referred to as 'shaping'. An essential part of shaping is a buffer memory, in which it is possible to store the packets, which, due to speed restrictions, cannot be forwarded (i.e. past point MP) immediately after they have arrived in the system. If it is wished to ensure that shaping does not alter the transfer sequence of the packets, FIFO (first in - first out) queue discipline is applied in the buffer memory, as in Figure 1.

Figure 2 shows a system according to the prior art for implementing the shaping of

several parallel traffic flows V1, ..., V5, in a situation, in which the flows in question are

alternated (multiplexed) to form a single aggregate flow Va. Multiplexing can take place

by applying, for example, the SFQ (Start-time Fair Queuing [1]) method. In the system

shown in the figure, the speed properties of a portion formed of packets representing

individual traffic flows (V1, ..., or V5) in an aggregate flow Va can be monitored and

limited. Measurement points (MP1, ..., MP5) relating to the multiplexed traffic flows

(V1, ..., V5) are all at the same location in the output of the multiplexer. The

measurement point MPi, only monitors packets representing the multiplexed traffic flow

Vi (i = 1, ..., 5). Similarly, when calculating the earliest permitted transfer moment

VTSi, only packets representing the traffic flow Vi are taken into account. The earliest

permitted transfer moment VTSi can be calculated for a multiplexed traffic flow Vi, for

example, as shown in equations 1, 2, and 3.

In the following, a situation is examined, in which it is desired to perform shaping

aggregate-portion-specifically, for example, to permit the monitoring and limiting of the

speed properties of a portion formed of packets representing the traffic flows V1 and V2

in the aggregate flow, the monitoring and limiting of the speed properties of a portion of

packets representing the traffic flows V3 and V4 in the aggregate flow, and, in addition,

the monitoring and limiting of the speed properties of the entire aggregate flow. In this

publication, shaping of this kind is referred to as aggregate-portion-specific shaping. In

the rest of the publication, such a situation will be expressed in such a way that traffic

flows V1 and V2 belong to a specific shaping group, V3 and V4 belong to a specific

second shaping group, and traffic flows V1, V2, V3, V4, and V5 belong to a specific

third shaping group. The shaping group including traffic flows V1 and V2 and the

shaping group including traffic flows V3 and V4 are included in the shaping group

including traffic groups V1, V2, V3, V4, and V5. This means that shaping can be

hierarchal.

In the system implemented according to Figure 2, aggregate-portion-specific shaping is

performed, but with the limitation that, when examined in terms of shaping, the

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aggregate portions always consist of traffic representing only a single incoming traffic flow V1, V2, V3, V4, or V5.

Figure 3 shows a system according to the prior art for implementing shaping corresponding to the example situation described above. The traffic flows V1 and V2 are multiplexed to form the traffic flow V1a and the shaper SH1a performs shaping resulting in the traffic flow V1b. The traffic flows V2 and V3 are multiplexed to form the traffic flow V2a and the shaper SH2a performs shaping resulting in the traffic flow V2b. The traffic flows V1b, V2b, and V5 are multiplexed to form the traffic flow V3a while the shaper SH3a performs shaping resulting in the traffic flow V3b.

Situations often arise, in which it is wished to ensure system transmittance with a higher privilege for one specific incoming traffic flow (e.g., V1), than for another traffic flow (e.g., V2). In the system according to Figure 3 when considering the traffic flows V1 and V2, this is traditionally resolved by controlling the multiplexer Mux1, in such a way that a packet can only be transferred to the FIFO1a queue if the queue is empty. Such an operation is referred to by the established term 'back pressure'. This prevents a situation arising, in which the queue FIFO1a could be filled up with packets representing the traffic flow V2, thus forcing the forwarding of packets representing the traffic flow V1, and which arrive later, to wait. Such operations complicate the system shown in Figure 3.

The following problems relate to the system according to Figure 3:

Problem 1) Even though the traffic flows V1b and V2b are monitored and limited with regard to the desired speed properties (e.g., CIR, PIR, CBS), the multiplexing with the traffic flow V5, performed in the multiplexer Mux3, results in there being no guarantee that the portions of the traffic flow V3b, formed of packets representing the traffic flows V1b and V2b, will be within the desired limits in terms of their speed properties. In other words, aggregate-portion-specific shaping cannot be performed.

Problem 2) The logical topology of the multiplexing and shaping system depends on

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how the traffic flows arriving in the system are bundled into different shaping groups. The system shown in Figure 3 is only responsible for bundling individual examples of the traffic flows into different shaping groups. In other words, the topology is arbitrary. This hampers the implementation of the shaping system. Particularly the circuit

5   implementation (e.g., using an ASIC (Application Specific Integrated Circuit) microcircuit) becomes difficult, while the software implementation is also challenging.

Summary

10   The present invention is intended to eliminate the defects of the prior art disclosed above and for this purpose create an entirely new type of method and equipment for performing shaping in packet-switched telecommunications. The aim of the invention is a method and system ~~equipment~~ for performing shaping in such a way as to avoid the aforementioned problems relating to the prior art.

15

The method according to the invention comprises:

- transferring digital information as constant or variable-length packets <u>to a buffer memory</u> as at least two separate traffic flows,<u> the traffic flows forming an aggregate</u>

20   <u>flow,</u>

- defining at least one shaping group, each <u>shaping group being a portion of the aggregate flow and including at least one of the traffic flows, and</u> ~~of which includes~~ at least one of the <u>shaping groups including</u> at least two <u>of the</u> traffic flows,

25

- setting restrictions of speed properties for at least <u>two</u> ~~one~~ shaping group<u>s,</u> ~~that includes at least two of the at least two traffic flows,~~

- defining an earliest permitted moment, at which a packet can be forwarded, as a

30   greatest value of Valid Time to Send -values of <u>the</u> ~~those~~ at least two shaping groups, to which a traffic flow represented by the packet to be forwarded belongs, and

- as a result of forwarding the packet, updating the Valid Time to Send -values of the
same shaping groups to which the forwarded packet belongs, a Valid Time to Send -
value of each shaping group expressing an earliest permitted moment, at which a packet
belonging under that shaping group can be forwarded without breaking restrictions of

5   speed properties of that shaping group.

The system ~~equipment~~ according to the invention comprises:

- means for receiving constant or variable-length packets carrying digital information,

10

- a controller configured to ~~means for classifying~~

_____ - classify a packet arriving in the equipment as representing one of traffic flows
arriving in the system, the traffic flows forming an aggregate flow, ~~equipment,~~

15

_____ - define ~~means for defining~~ at least two ~~one~~ shaping groups, each shaping group
being a portion of the aggregate flow and including at least one of the traffic flows, and
at least one of the shaping groups including at least two of the traffic flows, and

20   _____ - set ~~means for setting~~ restrictions of speed properties for the at least two ~~one~~
shaping groups, ~~that includes at least two of the traffic flows,~~

- means for forwarding the packets to an outgoing link or links,

25   - the controller being configured to: ~~means for defining~~

_____ - define an earliest permitted moment, at which a packet can be forwarded, as a
greatest value of Valid Time to Send -values of those at least two shaping groups, to
which a traffic flow represented by the packet to be forwarded belongs, and

30

_____ - update, ~~means for updating,~~ as a response to forwarding the packet, the Valid
Time to Send -values of the same shaping groups to which the forwarded packet

belongs, a Valid Time to Send -value of each shaping group expressing an earliest

permitted moment, at which a packet under that shaping group can be forwarded without

breaking restrictions of speed properties of that shaping group.

5   In the following, the invention is examined in greater detail with the aid of examples

according to the accompanying figures.

Brief Description of Figures

10   Figure 1 shows a block diagram of one way according to the prior art of monitoring and

limiting the speed properties of a traffic flow.

Figure 2 shows a block diagram of a system according to the prior art for implementing

the monitoring and limiting of the speed properties of several parallel traffic flows V1,

15   ..., V5, in a situation in which the flows in question are alternated (multiplexed) to form

a single aggregate flow Va.

Figure 3 shows a block diagram of a system according to the prior art concerning an

example of a situation, in which it is wished to perform shaping, in such a way that it is

20   possible to monitor and limit the speed properties in an aggregate flow of a portion

formed of packets representing the traffic flows V1 and V2, it is possible to monitor and

limit the speed properties in an aggregate flow of a portion formed on packets

representing the traffic flows V3 and V4, and, in addition, it is possible to monitor and

limit the speed properties of the aggregate flow V3.

25

Figure 4 shows a block diagram of a system according to the invention for performing

shaping, in such a way that the traffic flows arriving at the system can belong to shaping

groups in an arbitrary manner and the speed properties of the aggregate portion formed

of packets representing an arbitrary shaping group can be monitored and limited

30   (aggregate-portion-specific shaping).

The theoretical basis of the method according to the invention will become apparent

from the following examination.

Detailed description of embodiments

5   Traditionally, shaping is applied to a specific traffic flow, in which the packets move in

a temporal sequence, for example, according to Figures 1, 2, or 3. In the method

according to the invention, the central concept is a shaping group, i.e. an aggregate

portion. As stated above, the shaping group consists of the incoming traffic flows, the

speed properties of the portion of the aggregate flow formed of packets representing

10   which are monitored and limited using a restriction totality of specific speed properties

(such as a totality formed of the CIR, PIR, and CBS values). In the method according to

the invention, the VTS value is shaping-group-specific. The VTS value of a specific

shaping group thus expresses the earliest permitted moment in time, at which a packet

representing the relevant shaping group can be forwarded (first bit past the measurement

15   point), in order that a rule set for even one speed property (e.g., CIR) of the relevant

shaping {group} will not be broken. The measurement point too is logically shaping-

group-specific. In Figure 4, the measurement points of all the shaping groups k are at the

same location. Naturally it is possible to implement shaping equipment, in which the

measurement points MP of one or more shaping groups k are located separately. The

20   following examination is restricted to a situation, in which the measurement points MP

of all of the shaping groups are at the same location. It is then possible to refer simply to

the measurement point, instead of to the measurement point relating to a specific

shaping group.

25   An individual traffic flow can belong to one, several, or no shaping group k. If the traffic

flow does not belong to even one shaping group k, the shaping equipment naturally will

not set any limit to the speed properties of the traffic flow in question.

The earliest permitted moment, at which a single packet can be forwarded (first bit past

30   the measurement point), is determined on the basis of all the shaping groups k, under

which the traffic flow represented by the packet in question belongs. Stated more

precisely,

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$$VTS\_pk = \max(VTSk, \text{ packet belongs under shaping group k}), \qquad (4)$$

in which VTS_pk is the earliest moment in time, after which the packet can be forwarded (first bit past the measurement point), in order that not even one rule set for the speed properties associated with any shaping group concerning the packet will be broken, and VTSk is the VTS value of the shaping group k.

In the system according to Figure 4, the packet being examined is the packet closest to the multiplexer (i.e. at the head of the queue) of some FIFO queue. When the packet is offered to the multiplexer 10, and if the multiplexer 10 selects the packet in question, the packet is then moved immediately past the measurement point. Thus, there is no internal transfer delay in the multiplexer equipment. Thus, VTS_pk states the earliest moment in time, at which the packet is permitted to be offered to the multiplexer. For this reason, in Figure 4, the permit/refuse operations of the transfer of the packet are set between the FIFO queues I-L and the multiplexer 10.

When the packet is begun to be moved past the measurement point, the VTS values of all the shaping groups, under which the packet in question belongs, are updated. If the restrictions of the speed properties of the shaping group are expressed in the form CIR, PIR, CBS, the VTS values can be updated, for example, as shown in equations 1, 2, and 3.

In brief, the principle of the shaping system according to the invention is as follows:

Situation: Packet (first bit) passes measurement point.

Operations: Update all VTS values of the shaping groups, under which the packet in question belongs.

Situation: Determine earliest permitted moment, at which the packet can pass the measurement point.

Operations: Seek maximum of the VTS values of the shaping groups, under which the packet in question belongs.

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As can be surprisingly noticed from the above examination, the method according to the invention places no restrictions on how the traffic flows entering the system can be grouped into different shaping groups. By locating the measurement points of all the shaping groups according to Figure 4, it is possible to monitor and limit the speed properties of an aggregate portion formed on packets representing an arbitrary shaping group.

References:

[1] Pawan Goyal, Harric M. Vin, Haichen Cheng. *Start-time Fair Queuing: A Scheduling Algorithm for Integrated Services Packet Switching Networks.* Technical Report TR-96-02, Department of Computer Sciences, University of Texas Austin.

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Substitute Specification
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Claims:

1. A method for performing aggregate-portion-specific flow shaping in packet-switched telecommunications, in which method

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- digital information is transferred as constant or variable-length packets,

- the packets arrive in the system as at least two separate traffic flows (V1-VL, traffic flow),

10

- at least one shaping group (k), each of which includes at least one traffic flow (V1-VL) arriving in the system is defined in the system, and

- restrictions (e.g., CIR, PIR, CBS) are set for at least one shaping group (k), which

15   includes at least two traffic flows (V1-VL) arriving in the system,

characterized in that

- the earliest permitted moment, at which a packet in the system can be forwarded from

20   the system, is defined as the greatest value of the VTS values of all the shaping groups (k), to which shaping groups (k) the traffic flow (V1-VL) represented by the packet belongs, and

- as a result of the forwarding of the packet, the VTS values of the same shaping groups

25   (k) are updated, in which the VTS value of an individual shaping group (k) expresses the earliest permitted moment, at which a packet belonging under the relevant shaping group (k) can be forwarded, without breaking the restrictions of the speed properties of the shaping group (k) being examined.

30   2. A method according to Claim 1, **characterized** in that the traffic flows (V1-VL) contained in at least one shaping group (k) are all also included in some second shaping group (hierarchal shaping).

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3. Equipment for performing aggregate-portion-specific flow-shaping in packet-switched telecommunications, in which the equipment includes

- means for receiving constant or variable-length packets carrying digital information,

- means for classifying a packet arriving in the system as representing one of the traffic flows (V1-VL, traffic flow) arriving in the system,

- means for defining at least one shaping group (k) in the system, in such a way that each shaping group (k) includes at least one traffic flow (V1-VL) arriving in the system, and

- means for setting restrictions (e.g., CIR, PIR, CBS) for the speed properties for each least one such shaping group (k), which includes at least two traffic flows (V1-VL) arriving in the system, and

- means for forwarding packets to an outgoing link or links,

characterized in that the equipment includes

- means, which the aid of which it is possible to define the earliest permitted moment, at which a packet in the system can be forwarded, as the largest value of all the VTS values of the shaping groups (k), to which shaping groups (k) the traffic flow represented by the packet belongs, and with the aid of which means it is possible to update the VTS values of the same shaping groups (k) as a consequence of forwarding the packet, in which the VTS value of an individual shaping group (k) expresses the earliest permitted moment, at which a packet under the shaping group (k) in question can be forwarded, without breaking the restrictions of the speed properties of the shaping group being examined.

4. Equipment according to Claim 3, **characterized** in that the equipment includes means, with the aid of which it is possible to define all the traffic flows (V1-VL) contained in at least one shaping group (k) as belonging to some second shaping group (hierarchal shaping).

(57) Abstract:

The invention relates to a method and equipment for performing aggregate-portion-specific flow shaping in packet-switched telecommunications, in such a way that the traffic flows (V1–VL) arriving in the system can be arbitrarily bundled into shaping groups and the speed properties (CIR, PIR, CBS) of an aggregate portion formed of packets representing the arbitrary shaping group (k) can be monitored and limited (aggregate-portion-specific shaping group). The invention is based on the fact that the earliest permitted moment, at which a packet in the system can be forwarded, is defined as the greatest value of the VTS values of all the shaping groups to which the traffic flow represented by the packet belongs, and as a result of the forwarding of the packet, the VTS values of the same shaping groups (k) are updated, in which the VTS value of an individual shaping group (k) expresses the earliest permitted moment, at which a packet belonging under the relevant shaping group (k) can be forwarded, without breaking the restrictions of the speed properties of the shaping group (k) being examined.
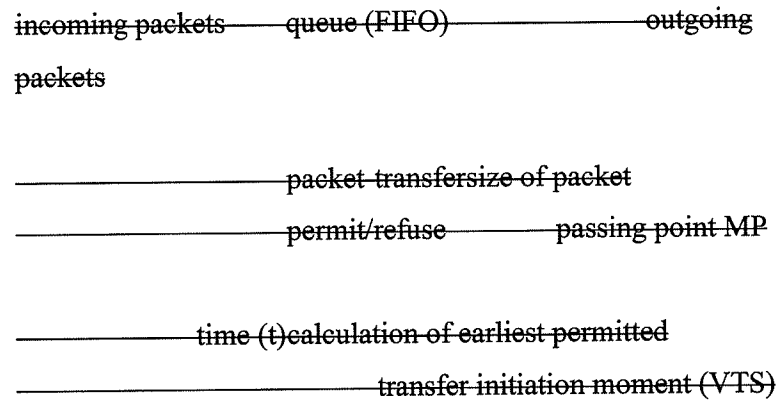
(Figure 4)

incoming packets — queue (FIFO) — outgoing
packets

——————————— packet transfersize of packet
——————————— permit/refuse — passing point MP

——————— time (t)calculation of earliest permitted
————————————— transfer initiation moment (VTS)

Figure 1

~~calculation of earliest permitted~~

~~transfer initiation moment (VTS)~~

~~for queue 1~~

~~VTS for queue 2, ...queue 3, 4, 5~~

~~(FIFO) queue 1~~

~~multiplexer 10, which selects the packet to be~~

~~transferred, from one queue FIFO1...FIFO5~~

~~at a time~~

~~MPi = Measurement point concerning packets (i = 1...5)~~

~~representing traffic flow Vi~~

~~s/K n = packet transfer~~

~~permit/refuse from~~

~~FIFO queue n (n = 1...5)~~

~~SFQ method (Start-time Fair Queuing)~~

~~shown in reference [1] for example can be~~

~~used in multiplexer.~~

~~**Figure 2**~~

(FIFO queue 1)

S / K n = packet transfer permit/refuse
from FIFO queue n (n = 1a, 2a, 3a)

MPn = measurement point concerning packets
(n = 1a, 2a, 3a) traffic flow Vn

Figure 3